



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

## NOTICE OF ALLOWANCE AND FEE(S) DUE

5514 7590 03/24/2008

FITZPATRICK CELLA HARPER & SCINTO  
30 ROCKEFELLER PLAZA  
NEW YORK, NY 10112

EXAMINER	
MRUK, GEOFFREY S	
ART UNIT	PAPER NUMBER
2853	

DATE MAILED: 03/24/2008

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/561,247	12/19/2005	Makoto Kubota	03500.109601	5989

TITLE OF INVENTION: PIEZOELECTRIC THIN FILM, METHOD OF MANUFACTURING PIEZOELECTRIC THIN FILM, PIEZOELECTRIC ELEMENT, AND INK JET RECORDING HEAD

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1440	\$300	\$0	\$1740	06/24/2008

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

### HOW TO REPLY TO THIS NOTICE:

#### I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

**II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.**

**III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.**

**IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.**

## PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Mail Stop ISSUE FEE**  
**Commissioner for Patents**  
**P.O. Box 1450**  
**Alexandria, Virginia 22313-1450**  
**or Fax** **(571)-273-2885**

**INSTRUCTIONS:** This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

5514                    7590                    03/24/2008  
**FITZPATRICK CELLA HARPER & SCINTO**  
30 ROCKEFELLER PLAZA  
NEW YORK, NY 10112

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

### Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the **Mail Stop ISSUE FEE** address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/561,247	12/19/2005	Makoto Kubota	03500.109601	5989

**TITLE OF INVENTION:** PIEZOELECTRIC THIN FILM, METHOD OF MANUFACTURING PIEZOELECTRIC THIN FILM, PIEZOELECTRIC ELEMENT, AND INK JET RECORDING HEAD

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1440	\$300	\$0	\$1740	06/24/2008
EXAMINER	ART UNIT	CLASS-SUBCLASS				
MRUK, GEOFFREY S	2853	347-070000				

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.  
 "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list  
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,  
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent):  Individual  Corporation or other private group entity  Government

4a. The following fee(s) are submitted:

Issue Fee  
 Publication Fee (No small entity discount permitted)  
 Advance Order - # of Copies \_\_\_\_\_

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

A check is enclosed.  
 Payment by credit card. Form PTO-2038 is attached.  
 The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number \_\_\_\_\_ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.  b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature \_\_\_\_\_

Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_

Registration No. \_\_\_\_\_

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/561,247	12/19/2005	Makoto Kubota	03500.109601	5989
5514	7590	03/24/2008	EXAMINER	
FITZPATRICK CELLA HARPER & SCINTO 30 ROCKEFELLER PLAZA NEW YORK, NY 10112				MRUK, GEOFFREY S
ART UNIT		PAPER NUMBER		
2853 DATE MAILED: 03/24/2008				

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 275 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 275 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

<b>Notice of Allowability</b>	Application No.	Applicant(s)
	10/561,247	KUBOTA ET AL.
	Examiner	Art Unit
	Geoffrey Mruk	2853

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTO-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1.  This communication is responsive to applicant's remarks dated 19 December 2007.
2.  The allowed claim(s) is/are 1-6 and 15-17.
3.  Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a)  All    b)  Some\*    c)  None    of the:
    1.  Certified copies of the priority documents have been received.
    2.  Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3.  Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

4.  A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5.  CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
  - (a)  including changes required by the Notice of Draftsperson's Patent Drawing Review ( PTO-948) attached
    - 1)  hereto or 2)  to Paper No./Mail Date \_\_\_\_\_.
  - (b)  including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6.  DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1.  Notice of References Cited (PTO-892)
2.  Notice of Draftsperson's Patent Drawing Review (PTO-948)
3.  Information Disclosure Statements (PTO/SB/08),  
Paper No./Mail Date 12/19/05, 9/25/07, 12/19/07
4.  Examiner's Comment Regarding Requirement for Deposit of Biological Material
5.  Notice of Informal Patent Application
6.  Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_\_.
7.  Examiner's Amendment/Comment
8.  Examiner's Statement of Reasons for Allowance
9.  Other \_\_\_\_\_.

/Stephen Meier/



### **EXAMINER'S AMENDMENT**

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mark A. Williamson on 14 March 2008.

The application has been amended as follows:

#### **IN THE SPECIFICATION:**

##### **Please amend the Specification as follows:**

Page 2, line 24, before "temperature" insert --a--; and after "than" insert --the--.

Page 11, line 20, after "designated" insert --by--.

Page 12, line 27, after "Mg," insert --and--.

Page 14, line 15, after "from" insert --the-- and after "and" insert --the--.

Page 17, line 10, replace "occupies" with --occupy--.

Page 17, line 11, replace "occupies" with --occupy--.

Page 19, line 19, replace "another" with --other--.

Page 19, line 25, replace "another" with --other--.

Page 20, line 7, replace "another" with --other--.

Page 23, line 26, replace "ratio." with --ratio is prepared and used--.

Page 27, line 7, replace "fast" with --quickly--.

Page 28, line 5, replace "This" with --The--.

Page 33, line 10, after "4," insert --and--.

Page 33, line 27, after "4," insert --and--.

Page 36, line 4, replace "another" with --other--.

Page 36, line 19, delete "any".

**IN THE ABSTRACT:**

**Please amend the Abstract as follows:**

Line 2, replace "portion" with --portions--.

**IN THE CLAIMS:**

**Cancel claims 7-14.**

**Replace claim 1 as below.**

-- 1. A piezoelectric thin film of perovskite crystals represented by a general formula  $Pb_{(1-x)}La_x(Zr_yTi_{1-y})O_3$  (where  $0 \leq x < 1$ ,  $0.05 \leq y \leq 1$ ), wherein a film thickness of the piezoelectric thin film is 1000 nm or more and 4000 nm or less, the surface of the piezoelectric thin film includes crystal grains respectively having an equivalent circle diameter of 200 nm or more, and crystal grains respectively having an equivalent

circle diameter of 40 nm or less, and the number of the crystal grains observed in the surface of the piezoelectric thin film and respectively having the equivalent circle diameter of 40 nm or less is 5% or more with respect to the total number of the crystal grains observed in the surface of the piezoelectric thin film.--

**Replace claim 2 as below.**

-- 2. The piezoelectric thin film according to claim 1, wherein the crystal grains observed in the surface of the piezoelectric thin film and respectively having the equivalent circle diameter of 200 nm or more are columnar crystals grown from a substrate.--

**Replace claim 3 as below.**

-- 3. The piezoelectric thin film according to claim 1, wherein the number of the crystal grains observed in the surface of the piezoelectric thin film and respectively having the equivalent circle diameter of 200 nm or more is 5% or more with respect to the total number of the crystal grains observed in the surface of the piezoelectric thin film.--

**Replace claim 5 as below.**

-- 5. The piezoelectric thin film according to claim 1,  
wherein a peak value of an equivalent circle diameter  
distribution of the crystal grains observed in the surface of  
the piezoelectric thin film is 50 nm or more and 200 nm or  
less.--

**Replace claim 15 as below.**

-- 15. A piezoelectric element comprising a piezoelectric  
thin film held between lower and upper electrodes, the  
piezoelectric thin film comprising the piezoelectric thin film  
according to claim 1.--

**Replace claim 16 as below.**

-- 16. A piezoelectric actuator comprising the  
piezoelectric element according to claim 15 as a driving  
source.--

**Replace claim 17 as below.**

-- 17. An ink jet system recording head comprising an ink discharge port, a pressure chamber communicating with the ink discharge port, a vibration plate constituting a part of the pressure chamber, and a piezoelectric element for imparting vibration to a vibration plate disposed outside the pressure chamber, the ink discharge port discharging ink in the pressure chamber by a volume change in the pressure chamber generated by the vibration plate, wherein the piezoelectric element comprises the piezoelectric element according to claim 15.--

**REASONS FOR ALLOWANCE**

The following is an examiner's statement of reasons for allowance:

The primary reason for allowance of claims 1-6 and 15-17 is the applicant's claimed invention includes a piezoelectric thin film where the surface of the piezoelectric thin film includes crystal grains respectively having an equivalent circle diameter of 200 nm or more, and crystal grains respectively having an equivalent circle diameter of 40 nm or less, and the number of the crystal grains observed in the surface of the piezoelectric thin film and respectively having the equivalent circle diameter of 40 nm or less is 5% or more with respect to the total number of the crystal grains observed in the surface of the piezoelectric thin film. It is this limitation, expressed in the claimed

combination not found, taught, or suggested in the prior art that makes these claims allowable over the prior art.

United States patent number 5,657,063 to Takahashi discloses an inkjet apparatus where “According to the ink jet apparatus of the present invention, as is apparent from the above description, the void ratio of the piezoelectric ceramic is 10% or less and the average crystal grain diameter is 10 $\mu$ m or less. It is therefore possible to provide an ink jet apparatus having excellent durability and high reliability” (Column 3, lines 34-39). However, Takahashi fails to disclose the number of the crystal grains observed in the surface of the piezoelectric thin film and respectively having the equivalent circle diameter of 40 nm or less is 5% or more with respect to the total number of the crystal grains observed in the surface of the piezoelectric thin film.

United States patent number 6,402,304 B1 to Qui et al. disclose a piezoelectric actuator where “Specifically speaking, this invention provides a piezoelectric actuator which comprises: a lower electrode; an upper electrode; and a piezoelectric film held between the lower electrode and the upper electrode, wherein the piezoelectric film is made of piezoelectric ceramic, and columnar crystal grains of the piezoelectric ceramic are random-oriented in a film thickness direction and a mean diameter of the columnar crystal grains is in the range of 100 nm to 15000 nm” (Column 2, lines 50-58).

United States patent number 6,565,997 B2 to Kashiwaya discloses a piezoelectric element where “When the average grain diameter is less than 1 $\mu$ m, the domain in the piezoelectric 1 does not develop sufficiently, which may result in a small flexural displacement. When the average grain diameter is more than 20 $\mu$ m, the

domain in the piezoelectric 1 is large but does not move easily, which may result in a small flexural displacement" (Column 5, lines 55-60). However, Kashiwaya fails to disclose the number of the crystal grains observed in the surface of the piezoelectric thin film and respectively having the equivalent circle diameter of 40 nm or less is 5% or more with respect to the total number of the crystal grains observed in the surface of the piezoelectric thin film.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Geoffrey Mruk whose telephone number is (571)272-2810. The examiner can normally be reached on Monday-Friday 7:30am - 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/G. M./  
Examiner, Art Unit 2853  
3/15/2008

/Stephen Meier/  
Supervisory Patent Examiner, Art Unit 2853